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## (54) Surface-mounting type semiconductor device

Oberflächenmontierbare Halbleiterpackung

Emballage semi-conducteur du type pour montage en surface

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- PATENT ABSTRACTS OF JAPAN vol. 006, no. 025 (E-094), 13 February 1982 & JP 56 146263 A (NEC CORP), 13 November 1981

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24.10.00

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## Description

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to a semiconductor device comprising two resin package bodies for accommodating a first semiconductor chip and a second semiconductor chip.

[0002] From DE-A-34 21 539 a semiconductor device and a substrate for mounting the same is known, comprising: a semiconductor chip; a resin package; interconnection leads having inner and outer parts; a heat dissipation lead having a stage part and a heat sink part extending in a direction perpendicular to a circuit board on which the device is to be mounted. The heat sink part has a lower edge that is flush with the outer lead parts.

[0003] From the document JP-A-62-263667 a semiconductor device is known which is formed so as to be mounted in a space saving manner on a substrate. This known semiconductor device comprises a resin package accommodating a chip on a stage, wherein connection terminals project from one side of the package to a substrate supporting the package.

[0004] In order to improve the efficiency for mounting semiconductor devices on a support substrate such as a printed circuit board, a package structure designed for the surface mounting technology (SMT) is used extensively. By using the surface mounting technology, the semiconductor device can be mounted on the circuit board without providing holes for inserting leads of the device. The soldering of the leads is achieved by merely placing the device on the circuit board and passing through a heating furnace for causing a reflowing of the solder alloy. Thereby, the efficiency of the mounting process is improved significantly and the fabrication cost of electronic apparatuses that use the semiconductor devices is significantly reduced.

[0005] In order to mount the semiconductor devices as many as possible on a single support substrate, a so-called single in-line package (SIP) is proposed. In the single in-line package, the leads are provided along a single edge of a flat package body to extend perpendicularly with respect to the edge, and the package body is held upright on the substrate by inserting the leads into the corresponding holes of the substrate. As the package body is held vertically on the substrate, one can increase the number of the packages that are mounted on the single substrate. Further, such a structure is advantageous for cooling the device.

[0006] In order to combine the advantageous feature of the single in-line package with the advantageous feature of the surface mounting technology, a package structure shown in FIG.1 is proposed in the United States Patent 4,975,763.

[0007] Referring to FIG.1, the package designated by a numeral 1 includes a flat resin package body 2 that accommodates therein a semiconductor chip 3. At an edge 2a of the flat package body 2, there are provided

a number of leads each having an inner lead part 4a connected to a bonding pad of the chip 3 and an outer lead part 4b extending outward from the edge 2a. Further, the outer lead part 4b of the leads 4 is bent laterally with respect to the extending direction of the leads 4. In order to support the package body 2 on the substrate at the time of mounting, there is provided a pair of studs 5a each including a stop portion 6 and a cylindrical clip portion 7 of a reduced diameter for inserting into a corresponding hole provided on the substrate.

[0008] FIG.2 shows the mounting of the package 1 on a substrate 8, wherein the substrate 8 is formed with a hole 8a for holding the clip portion 7 of the stud 5. There, the portion 7 is inserted into the hole 8a as shown in FIG.2 and the package body 2 is held upright on the substrate 8. The substrate 8 carries thereon a conductor pattern 8b for wiring, and the lead 4 is contacted with the conductor pattern 8b when the package 1 is held on the substrate 8. By passing the substrate 8 together with the package 1 in the state shown in FIG.2, the soldering alloy provided on the conductor pattern 8b causes a reflow and the lead 4 is soldered firmly upon the conductor pattern 8.

[0009] In this conventional package structure, there is a problem in that one has to provide the hole 8a on the substrate 8 in correspondence to the stud 5 for holding the package body 2 on the substrate 8. As each lead 4 has to engage with corresponding pattern 8b when the package is mounted, it is necessary that the hole 8a be formed with high precision. This requirement is particularly acute in the recent semiconductor devices that have a large number of leads on the package body. Obviously, such a formation of the hole and the insertion of the stud into the hole undermine the advantageous feature of the surface mounting technology, and the efficiency of mounting is inevitably deteriorated.

[0010] Meanwhile, there are various semiconductor devices that generate heat upon operation. Thus, there are needs for a semiconductor package that facilitates efficient cooling of the device. The conventional package of FIG.1 has a drawback with respect to this point in that the package lacks a cooling fin. Thus, the dissipation of the heat has to be achieved via the resin package body. As will be easily understood, such a process of heat dissipation is inefficient and the package structure of FIG.1 can be used only for those devices that produce little heat. The process for mounting a cooling fin on the resin package body complicates the fabrication process of the device.

### SUMMARY OF THE INVENTION

[0011] Accordingly, it is a general object of the present invention to provide a novel and useful semiconductor device, wherein the problems of the prior art devices are eliminated.

[0012] Another and more specific object of the present invention is to provide a semiconductor device

which has an improved mechanical stability associated with a high efficiency for heat dissipation.

[0013] According to the present invention this object is solved by a semiconductor device which is characterized by:

first and second semiconductor chips that are separate from each other;

a first resin package body for accommodating said first semiconductor chip, said first resin package body having a lower edge;

a second resin package body for accommodating said second semiconductor chip, said second resin package body having a lower edge;

first group interconnection leads provided on said first package body to project outward from said first package body at said lower edge thereof, said first group interconnection leads including a plurality of leads each having an inner lead part held inside the first package body and connected electrically to said first semiconductor chip, and an outer lead part located outside said first resin package body for engagement with a substrate

second group interconnection leads provided on said second package body to project outward from said second package body at said lower edge thereof, said second group interconnection leads including a plurality of leads each having an inner lead part held inside the second resin package body and connected electrically to said second semiconductor chip, and an outer lead part located outside the package body for engagement with said substrate and

a heat dissipation lead connecting said first resin package body and said second resin package body with each other, said heat dissipation lead comprising a first stage part embedded within said first resin package body for holding said first semiconductor chip thereon, a second stage part embedded within said second resin package body for holding said second semiconductor chip thereon, and a heat sink part located outside said first and second resin package bodies for bridging said first stage part and said second stage part;

each lead forming said first group interconnection leads having said outer lead part at a level substantially flush with said outer lead part of said second group interconnection leads such that said semiconductor device is held upright on the substrate by said outer lead parts of said first and second group interconnection leads.

[0014] According to the present invention, one can provide a semiconductor device that can be held upright on a substrate such as a printed circuit board while maintaining an excellent efficiency of heat dissipation. It should be noted that the device is held upright on the substrate by a first group of interconnection leads and

a second group of interconnection leads. Thus, the device is suitable for the mounting on a substrate by the surface mounting technology. Simultaneously, the device achieves an efficient cooling by the heat sink parts that connects the first and second resin package bodies.

[0015] Further improved embodiments of the invention result from the subclaims.

[0016] Other objects and further features of the present invention will become apparent from the following detailed description when read in conjunction with the attached drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a diagram showing a conventional semiconductor package for surface mounting;

FIG. 2 is a diagram showing the mounting of the semiconductor device on a substrate;

FIG. 3 is a diagram showing a semiconductor device having a package according an embodiment of the present invention in a perspective view;

FIG. 4 is a diagram showing the semiconductor device of FIG. 3 in a side view in the state that the device is mounted on a substrate;

FIG. 5 is a diagram showing the internal structure of the device of FIG. 3 in the state that the heat dissipation lead is extended;

FIG. 6 is a diagram showing a modification of the device of FIG. 3; and

FIG. 7 is a diagram showing another modification of the device of FIG. 3 in a cross sectional view.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Hereinafter, the description will be made on a semiconductor device 70 according to an embodiment of the present invention with reference to FIGS. 3 - 7, wherein FIG. 3 shows the device 70 in a perspective view while FIG. 4 shows the device 70 in a side view.

[0019] Referring to FIG. 3, the semiconductor device 70 includes first and second resin package bodies 71 and 72 connected with each other by a heat dissipation lead 73. As shown in the cross sectional view of FIG. 4, the heat dissipation lead 73 includes a first stage part 73a supporting thereon a first semiconductor chip 76 and embedded in the first resin package body 71, and a second stage part 73b supporting thereon a second semiconductor chip 77 and embedded in the second resin package body 72. Further, the heat dissipation lead 73 includes a heat sink part 73c that is located outside the package bodies 71 and 72 and connecting the first and second stage parts 73a and 73b with each other. There, the heat sink part 73c extends upward from the upper edge of the package bodies 71 and 72. On the other hand, interconnection leads 74 are provided

to extend in the downward direction at the lower edge of the package body 71, while interconnection leads 75 are provided to extend in the downward direction at the lower edge of the package body 72. It should be noted that each interconnection lead 74 is connected to the semiconductor chip 76 by a bonding wire 74a. Similarly, each interconnection lead 75 is connected to the semiconductor chip 77 by a bonding wire 75a. Further, the outer ends of the interconnection leads 74 and 75 are bent laterally at substantially an identical level as indicated in FIG.4. Thereby, the semiconductor device 70 is held upright on the substrate 19 by the interconnection leads 74 and 75 as shown in FIGS.3 and 4.

[0020] FIG.5 shows the semiconductor device 70 in the state that the heat dissipation lead 73 is unfolded. In FIG.5, it will be seen that there are provided anchor holes 78 and cutouts 79 for improving the intimate contact between the resin that forms the package body and the heat dissipation lead 73. Further, V-shaped grooves 80 are provided on the heat dissipation lead 73 for facilitating the bending thereof. The molding of the device is achieved in the state of FIG.5, and the heat dissipation lead 73 is bent subsequently to form the device shown in FIG.3.

[0021] FIG.6 shows a semiconductor device 80 according to a modification of the device 70 wherein interconnection leads 81 and 82 are used in place of the interconnection leads 74 and 75. There, the leads forming the interconnection leads 81 are bent laterally in opposite directions to avoid any obstacles formed on the surface of the substrate 19.

[0022] FIG.7 shows a semiconductor device 90 according to another modification of the device 80 wherein interconnection leads 91 and 92 are bent at the lower edge of the package bodies 71 and 72. By constructing the device as such, the signal delay caused by the interconnection lead is minimized. Associated therewith, the penetration of noise into the semiconductor circuits in the chips 76 and 77 via the interconnection leads 91 and 92 is minimized.

[0023] Further, the present invention is not limited to the embodiment described heretofore, but various variations and modifications may be made without departing from the scope of the invention.

## Claims

1. A semiconductor device characterized by:

first and second semiconductor chips (76, 77) that are separate from each other;  
a first resin package body (71) for accommodating said first semiconductor chip, said first resin package body having a lower edge;  
a second resin package body (72) for accommodating said second semiconductor chip, said second resin package body having a lower

edge;

first group interconnection leads (74) provided on said first package body to project outward from said first package body at said lower edge thereof, said first group interconnection leads including a plurality of leads each having an inner lead part held inside the first package body and connected electrically to said first semiconductor chip, and an outer lead part located outside said first resin package body for engagement with a substrate (19);

second group interconnection leads (75) provided on said second package body to project outward from said second package body at said lower edge thereof, said second group interconnection leads including a plurality of leads each having an inner lead part held inside the second resin package body and connected electrically to said second semiconductor chip, and an outer lead part located outside the package body for engagement with said substrate (19); and

a heat dissipation lead (73) connecting said first resin package body and said second resin package body with each other, said heat dissipation lead comprising a first stage part (73a) embedded within said first resin package body for holding said first semiconductor chip thereon, a second stage part (73b) embedded within said second resin package body for holding said second semiconductor chip thereon, and a heat sink part located outside said first and second resin package bodies for bridging said first stage part and said second stage part; each lead forming said first group interconnection leads (74) having said outer lead part at a level substantially flush with said outer lead part of said second group interconnection leads (75) such that said semiconductor device is held upright on the substrate (19) by said outer lead parts of said first and second group interconnection leads.

2. A semiconductor device as claimed in claim 1, wherein said heat sink part (73c) is projecting outwardly from the top edge of said first and said second resin package bodies so as to bridge said first stage part (73a) and said second stage part (73b) at the top of said first and second resin package bodies.

3. A semiconductor device as claimed in claim 1 or 2, characterized in that interconnection leads (74, 75) are provided to extend in the downward direction at the lower edge of said first and second resin package bodies, respectively, said interconnection leads (74, 75) are bent laterally at substantially an identical level for holding the semiconductor device (70)

upright on a substrate.

## Patentansprüche

### 1. Halbleitervorrichtung, gekennzeichnet durch:

erste und zweite Halbleiterchips (76, 77), die voneinander getrennt sind;  
einen ersten Harzpackungskörper (71) zum Aufnehmen des ersten Halbleiterchips, welcher erste Harzpackungskörper einen unteren Rand hat;  
einen zweiten Harzpackungskörper (72) zum Aufnehmen des zweiten Halbleiterchips, welcher zweite Harzpackungskörper einen unteren Rand hat;  
eine erste Gruppe von Zwischenverbindungsleitungen (74), die an dem ersten Packungskörper vorgesehen sind, um sich von dem ersten Packungskörper an dessen unterem Rand nach außen zu erstrecken, welche erste Gruppe von Zwischenverbindungsleitungen eine Vielzahl von Leitungen enthält, die jeweils einen inneren Leitungsteil haben, der in dem ersten Packungskörper enthalten ist und mit dem ersten Halbleiterchip elektrisch verbunden ist, und einen äußeren Leitungsteil, der außerhalb des ersten Harzpackungskörpers zum Kontakt mit einem Substrat (19) angeordnet ist;  
eine zweite Gruppe von Zwischenverbindungsleitungen (75), die an dem zweiten Packungskörper vorgesehen sind, um sich von dem zweiten Packungskörper an dessen unterem Rand nach außen zu erstrecken, welche zweite Gruppe von Zwischenverbindungsleitungen eine Vielzahl von Leitungen enthält, die jeweils einen inneren Leitungsteil haben, der in dem zweiten Harzpackungskörper enthalten ist und mit dem zweiten Halbleiterchip elektrisch verbunden ist, und einen äußeren Leitungsteil, der außerhalb des Packungskörpers zum Kontakt mit dem Substrat (19) angeordnet ist; und  
eine Wärmeableitungsleitung (73), die den ersten Harzpackungskörper und den zweiten Harzpackungskörper miteinander verbindet, welche Wärmeableitungsleitung einen ersten Stufenteil (73a) umfaßt, der in dem ersten Harzpackungskörper eingebettet ist, um den ersten Halbleiterchip auf sich zu halten, einen zweiten Stufenteil (73b), der in dem zweiten Harzpackungskörper eingebettet ist, um den zweiten Halbleiterchip auf sich zu halten, und einen Kühlkörperteil, der außerhalb der ersten und zweiten Harzpackungskörper zum Überbrücken des ersten Stufenteils und des zweiten Stufenteils angeordnet ist;  
wobei bei jeder Leitung, die die erste Gruppe

von Zwischenverbindungsleitungen (74) bildet, der äußere Leitungsteil auf einem Niveau angeordnet ist, das mit dem äußeren Leitungsteil der zweiten Gruppe von Zwischenverbindungsleitungen (75) im wesentlichen bündig ist, so daß die Halbleitervorrichtung durch die äußeren Leitungsteile der ersten und zweiten Gruppen von Zwischenverbindungsleitungen auf dem Substrat (19) aufrecht gehalten wird.

2. Halbleitervorrichtung nach Anspruch 1, bei der der Kühlkörperteil (73c) aus dem oberen Rand der ersten und zweiten Harzpackungskörper herausragt, um den ersten Stufenteil (73a) und den zweiten Stufenteil (73b) oben auf den ersten und zweiten Harzpackungskörpern zu überbrücken.
3. Halbleitervorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß Zwischenverbindungsleitungen (74, 75) vorgesehen sind, um sich am unteren Rand der ersten bzw. zweiten Harzpackungskörper in die abwärtige Richtung zu erstrecken, welche Zwischenverbindungsleitungen (74, 75) im wesentlichen auf einem identischen Niveau seitwärts gebogen sind, um die Halbleitervorrichtung (70) auf einem Substrat aufrecht zu halten.

## Revendications

### 1. Dispositif semi-conducteur caractérisé par :

des première et seconde puces semi-conductrices (76, 77) qui sont séparées l'une de l'autre ;  
un premier corps de boîtier en résine (71) pour contenir ladite première puce semi-conductrice, ledit premier corps de boîtier en résine ayant un bord inférieur ;  
un second corps de boîtier de résine (72) pour contenir ladite seconde puce semi-conductrice, ledit second corps de boîtier de résine ayant un bord inférieur ;  
des premiers conducteurs d'interconnexion de groupe (74) fournis sur ledit premier corps de boîtier en résine pour faire saillie vers l'extérieur dudit premier corps de boîtier en résine sur ledit bord inférieur de celui-ci, lesdits premiers conducteurs d'interconnexion de groupe comprenant une pluralité de conducteurs ayant chacun une partie de conducteur interne maintenue à l'intérieur du premier corps de boîtier et électriquement raccordée à ladite première puce semi-conductrice, et une partie de conducteur externe située en dehors dudit premier corps de boîtier en résine pour un engagement avec un substrat (19) ;  
des seconds conducteurs d'interconnexion de

groupe (75) fournis sur ledit second corps de boîtier pour faire saillie vers l'extérieur à partir dudit second corps de boîtier sur ledit bord inférieur de celui-ci, lesdits seconds conducteurs d'interconnexion de groupe comprenant une pluralité de conducteurs ayant chacun une partie de conducteur interne maintenue à l'intérieur dudit second corps de boîtier de résine et électriquement raccordée à ladite seconde puce semi-conductrice, et une partie de conducteur externe située à l'extérieur du corps de boîtier pour un engagement avec ledit substrat (19) ; et

un conducteur de dissipation thermique (73) reliant ledit premier corps de boîtier en résine et ledit second corps de boîtier de résine l'un avec l'autre, ledit conducteur de dissipation thermique comprenant une première partie d'étage (73a) incorporée dans ledit premier corps de boîtier en résine pour maintenir ladite première puce semi-conductrice sur celui-ci, une seconde partie d'étage (73b) incorporée avec ledit second corps de boîtier de résine pour maintenir ladite seconde puce semi-conductrice sur celui-ci, et une partie de radiateur thermique située à l'extérieur desdits premier et second corps de boîtier en résine pour former un pont entre ladite première partie d'étage et ladite seconde partie d'étage ;

chaque conducteur formant lesdits premiers conducteurs d'interconnexion de groupe (74) ayant ladite partie de conducteur externe à un niveau substantiellement à fleur avec ladite partie de conducteur externe desdits seconds conducteurs d'interconnexion de groupe (75) pour que ledit dispositif semi-conducteur soit maintenu vertical sur le substrat (19) par lesdites parties de conducteur externes desdits premier et second conducteurs d'interconnexion de groupe.

positif semi-conducteur (70) vertical sur un substrat.

2. Dispositif semi-conducteur selon la revendication 1, dans lequel ladite partie de radiateur thermique (73c) fait saillie vers l'extérieur à partir du bord supérieur desdits premier et second corps de boîtier en résine afin de former un pont entre la première partie d'étage (73a) et ladite seconde partie d'étage (73b) sur le sommet desdits premier et second corps de boîtier en résine.

3. Dispositif semi-conducteur selon la revendication 1 ou 2, caractérisé en ce que des conducteurs d'interconnexion (74, 75) sont fournis pour s'étendre dans la direction vers le bas sur le bord inférieur desdits premier et second corps de boîtier en résine, respectivement, lesdits conducteurs d'interconnexion (74, 75) sont pliés latéralement substantiellement à un niveau identique pour maintenir le dis-

FIG. 1  
PRIOR ART

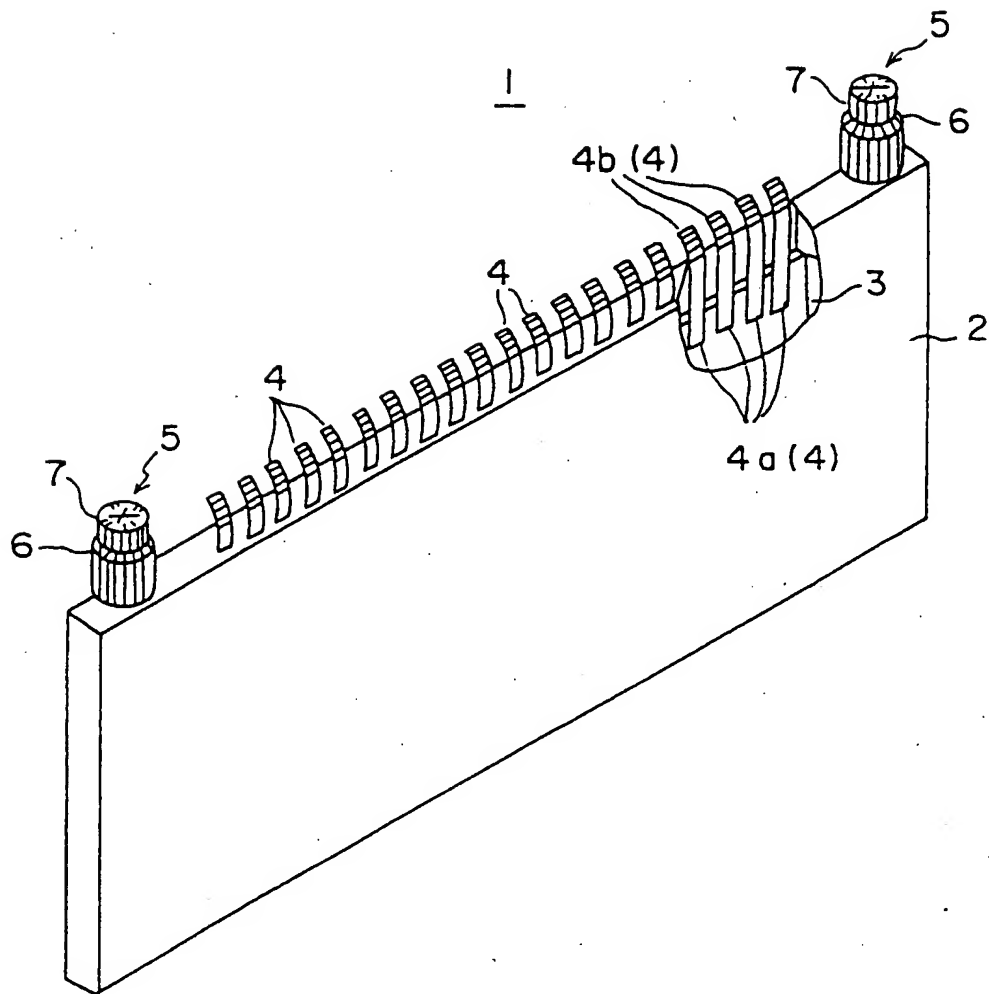


FIG. 2 PRIOR ART

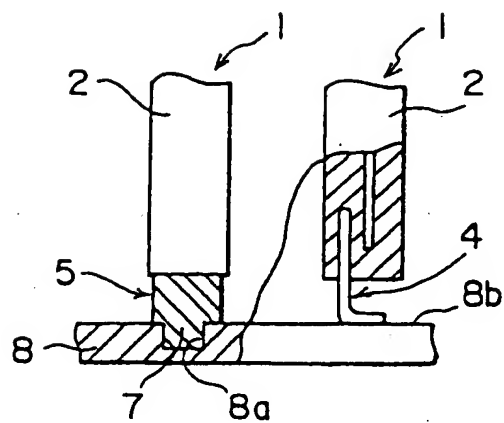




FIG. 3

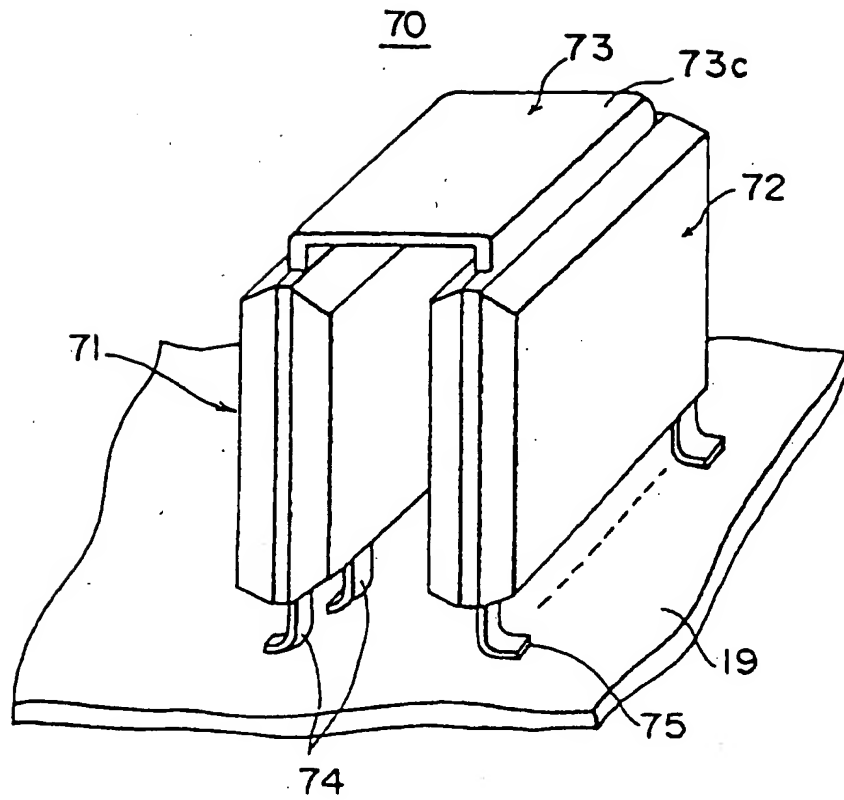


FIG. 4

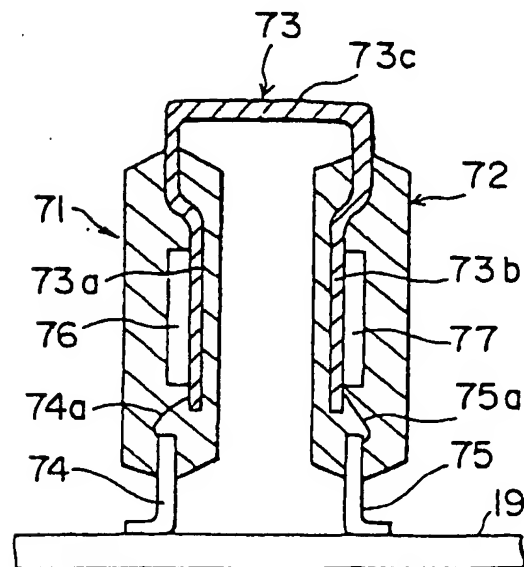


FIG. 5

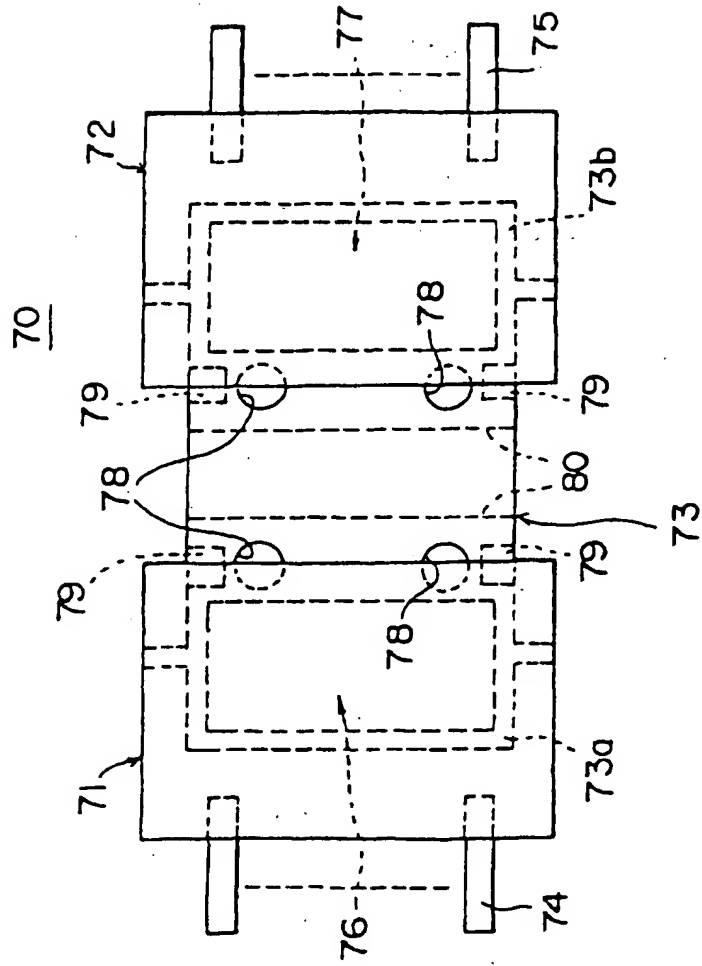


FIG. 6

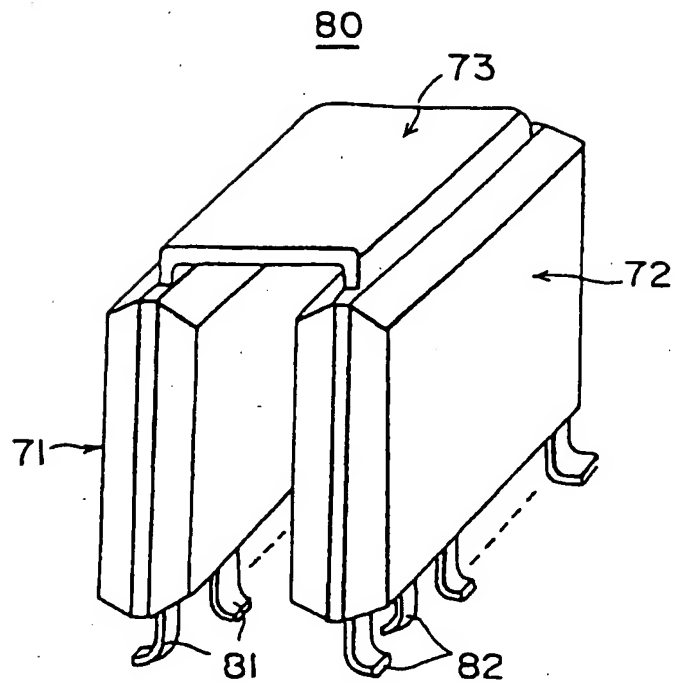
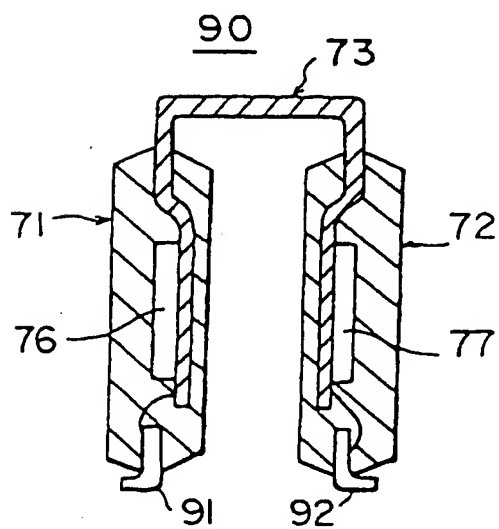


FIG. 7





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## EUROPEAN PATENT APPLICATION

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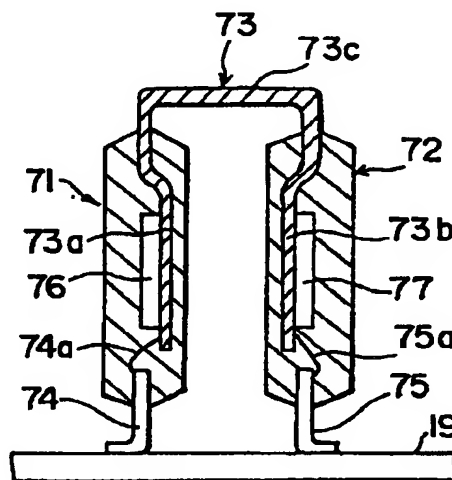
### Remarks:

This application was filed on 04 - 12 - 1996 as a  
divisional application to the application mentioned  
under INID code 62.

### (54) Surface-mounting type semiconductor device

(57) A semiconductor device comprises a first and a second semiconductor chip that are separate from each other, a first resin package body for accommodating said first semiconductor chip and a second resin package body for accommodating said second semiconductor chip. Each of the resin package bodies comprises groups of interconnection leads at the lower edge thereof and a heat dissipation lead connecting the first resin package body and the second resin package body with each other. The heat sink part is projecting outwardly from the top edge of the first and second resin package body so as to bridge and connect the first and second resin package bodies. The semiconductor device is held upright on a substrate and is suitable for the mounting on the substrate by the surface mounting technology. Simultaneously, the device achieves an efficient cooling by the heat sink part that connects the first and second resin package bodies.

FIG. 4



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## Description

### BACKGROUND OF THE INVENTION

The present invention relates to a semiconductor device comprising two resin package bodies for accommodating a first semiconductor chip and a second semiconductor chip.

From DE-A-34 21 539 a semiconductor device and a substrate for mounting the same is known, comprising: a semiconductor chip; a resin package; interconnection leads having inner and outer parts; a heat dissipation lead having a stage part and a heat sink part extending in a direction perpendicular to a circuit board on which the device is to be mounted. The heat sink part has a lower edge that is flush with the outer lead parts.

From the document JP-A-62-263667 a semiconductor device is known which is formed so as to be mounted in a space saving manner on a substrate. This known semiconductor device comprises a resin package accommodating a chip on a stage, wherein connection terminals project from one side of the package to a substrate supporting the package.

In order to improve the efficiency for mounting semiconductor devices on a support substrate such as a printed circuit board, a package structure designed for the surface mounting technology (SMT) is used extensively. By using the surface mounting technology, the semiconductor device can be mounted on the circuit board without providing holes for inserting leads of the device. The soldering of the leads is achieved by merely placing the device on the circuit board and passing through a heating furnace for causing a reflowing of the solder alloy. Thereby, the efficiency of the mounting process is improved significantly and the fabrication cost of electronic apparatuses that use the semiconductor devices is significantly reduced.

In order to mount the semiconductor devices as many as possible on a single support substrate, a so-called single in-line package (SIP) is proposed. In the single in-line package, the leads are provided along a single edge of a flat package body to extend perpendicularly with respect to the edge, and the package body is held upright on the substrate by inserting the leads into the corresponding holes of the substrate. As the package body is held vertically on the substrate, one can increase the number of the packages that are mounted on the single substrate. Further, such a structure is advantageous for cooling the device.

In order to combine the advantageous feature of the single in-line package with the advantageous feature of the surface mounting technology, a package structure shown in FIG.1 is proposed in the United States Patent 4,975,763.

Referring to FIG.1, the package designated by a numeral 1 includes a flat resin package body 2 that accommodates therein a semiconductor chip 3. At an edge 2a of the flat package body 2, there are provided a

number of leads each having an inner lead part 4a connected to a bonding pad of the chip 3 and an outer lead part 4b extending outward from the edge 2a. Further, the outer lead part 4b of the leads 4 is bent laterally with respect to the extending direction of the leads 4. In order to support the package body 2 on the substrate at the time of mounting, there is provided a pair of studs 5a each including a stop portion 6 and a cylindrical clip portion 7 of a reduced diameter for inserting into a corresponding hole provided on the substrate.

FIG.2 shows the mounting of the package 1 on a substrate 8, wherein the substrate 8 is formed with a hole 8a for holding the clip portion 7 of the stud 5. There, the portion 7 is inserted into the hole 8a as shown in FIG.2 and the package body 2 is held upright on the substrate 8. The substrate 8 carries thereon a conductor pattern 8b for wiring, and the lead 4 is contacted with the conductor pattern 8b when the package 1 is held on the substrate 8. By passing the substrate 8 together with the package 1 in the state shown in FIG.2, the soldering alloy provided on the conductor pattern 8b causes a reflow and the lead 4 is soldered firmly upon the conductor pattern 8.

In this conventional package structure, there is a problem in that one has to provide the hole 8a on the substrate 8 in correspondence to the stud 5 for holding the package body 2 on the substrate 8. As each lead 4 has to engage with corresponding pattern 8b when the package is mounted, it is necessary that the hole 8a be formed with high precision. This requirement is particularly acute in the recent semiconductor devices that have a large number of leads on the package body. Obviously, such a formation of the hole and the insertion of the stud into the hole undermine the advantageous feature of the surface mounting technology, and the efficiency of mounting is inevitably deteriorated.

Meanwhile, there are various semiconductor devices that generate heat upon operation. Thus, there are needs for a semiconductor package that facilitates efficient cooling of the device. The conventional package of FIG.1 has a drawback with respect to this point in that the package lacks a cooling fin. Thus, the dissipation of the heat has to be achieved via the resin package body. As will be easily understood, such a process of heat dissipation is inefficient and the package structure of FIG.1 can be used only for those devices that produce little heat. The process for mounting a cooling fin on the resin package body complicates the fabrication process of the device.

### SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a novel and useful semiconductor device, wherein the problems of the prior art devices are eliminated.

Another and more specific object of the present invention is to provide a semiconductor device which has an improved mechanical stability associated with a

high efficiency for heat dissipation.

According to the present invention this object is solved by a semiconductor device which is characterized by:

first and second semiconductor chips that are separate from each other;  
 a first resin package body for accommodating said first semiconductor chip, said first resin package body having a lower edge;  
 a second resin package body for accommodating said second semiconductor chip, said second resin package body having a lower edge;  
 first group interconnection leads provided on said first package body to project outward from said first package body at said lower edge thereof, said first group interconnection leads including a plurality of leads each having an inner lead part held inside the first package body and connected electrically to said first semiconductor chip, and an outer lead part located outside said first resin package body for engagement with a substrate  
 second group interconnection leads provided on said second package body to project outward from said second package body at said lower edge thereof, said second group interconnection leads including a plurality of leads each having an inner lead part held inside the second resin package body and connected electrically to said second semiconductor chip, and an outer lead part located outside the package body for engagement with said substrate and  
 a heat dissipation lead connecting said first resin package body and said second resin package body with each other, said heat dissipation lead comprising a first stage part embedded within said first resin package body for holding said first semiconductor chip thereon, a second stage part embedded within said second resin package body for holding said second semiconductor chip thereon, and a heat sink part located outside said first and second resin package bodies for bridging said first stage part and said second stage part;  
 each lead forming said first group interconnection leads having said outer lead part at a level substantially flush with said outer lead part of said second group interconnection leads such that said semiconductor device is held upright on the substrate by said outer lead parts of said first and second group interconnection leads.

According to the present invention, one can provide a semiconductor device that can be held upright on a substrate such as a printed circuit board while maintaining an excellent efficiency of heat dissipation. It should be noted that the device is held upright on the substrate by a first group of interconnection leads and a second group of interconnection leads. Thus, the device is suitable for the mounting on a substrate by the surface

mounting technology. Simultaneously, the device achieves an efficient cooling by the heat sink parts that connects the first and second resin package bodies.

Further improved embodiments of the invention result from the subclaims.

Other objects and further features of the present invention will become apparent from the following detailed description when read in conjunction with the attached drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram showing a conventional semiconductor package for surface mounting;

FIG. 2 is a diagram showing the mounting of the semiconductor device on a substrate;

FIG. 3 is a diagram showing a semiconductor device having a package according an embodiment of the present invention in a perspective view;

FIG. 4 is a diagram showing the semiconductor device of FIG. 3 in a side view in the state that the device is mounted on a substrate;

FIG. 5 is a diagram showing the internal structure of the device of FIG. 3 in the state that the heat dissipation lead is extended;

FIG. 6 is a diagram showing a modification of the device of FIG. 3; and

FIG. 7 is a diagram showing another modification of the device of FIG. 3 in a cross sectional view.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the description will be made on a semiconductor device 70 according to an embodiment of the present invention with reference to FIGS. 3 - 7, wherein FIG. 3 shows the device 70 in a perspective view while FIG. 4 shows the device 70 in a side view.

Referring to FIG.3, the semiconductor device 70 includes first and second resin package bodies 71 and 72 connected with each other by a heat dissipation lead 73. As shown in the cross sectional view of FIG.4, the heat dissipation lead 73 includes a first stage part 73a supporting thereon a first semiconductor chip 76 and embedded in the first resin package body 71, and a second stage part 73b supporting thereon a second semiconductor chip 77 and embedded in the second resin package body 72. Further, the heat dissipation lead 73 includes a heat sink part 73c that is located outside the package bodies 71 and 72 and connecting the first and second stage parts 73a and 73b with each other. There, the heat sink part 73c extends upward from the upper edge of the package bodies 71 and 72. On the other hand, interconnection leads 74 are provided to extend in the downward direction at the lower edge of the package body 71, while interconnection leads 75 are provided to extend in the downward direction at the lower edge of the package body 72. It should be noted that each interconnection lead 74 is connected to the semi-

conductor chip 76 by a bonding wire 74a. Similarly, each interconnection lead 75 is connected to the semiconductor chip 77 by a bonding wire 75a. Further, the outer ends of the interconnection leads 74 and 75 are bent laterally at substantially an identical level as indicated in FIG.4. Thereby, the semiconductor device 70 is held upright on the substrate 19 by the interconnection leads 74 and 75 as shown in FIGS.3 and 4.

FIG.5 shows the semiconductor device 70 in the state that the heat dissipation lead 73 is unfolded. In FIG.5, it will be seen that there are provided anchor holes 78 and cutouts 79 for improving the intimate contact between the resin that forms the package body and the heat dissipation lead 73. Further, V-shaped grooves 80 are provided on the heat dissipation lead 73 for facilitating the bending thereof. The molding of the device is achieved in the state of FIG.5, and the heat dissipation lead 73 is bent subsequently to form the device shown in FIG.3.

FIG.6 shows a semiconductor device 80 according to a modification of the device 70 wherein interconnection leads 81 and 82 are used in place of the interconnection leads 74 and 75. There, the leads forming the interconnection leads 81 are bent laterally in opposite directions to avoid any obstacles formed on the surface of the substrate 19.

FIG.7 shows a semiconductor device 90 according to another modification of the device 80 wherein interconnection leads 91 and 92 are bent at the lower edge of the package bodies 71 and 72. By constructing the device as such, the signal delay caused by the interconnection lead is minimized. Associated therewith, the penetration of noise into the semiconductor circuits in the chips 76 and 77 via the interconnection leads 91 and 92 is minimized.

Further, the present invention is not limited to the embodiment described heretofore, but various variations and modifications may be made without departing from the scope of the invention.

## Claims

### 1. A semiconductor device characterized by:

first and second semiconductor chips (76, 77) that are separate from each other;  
a first resin package body (71) for accommodating said first semiconductor chip, said first resin package body having a lower edge;  
a second resin package body (72) for accommodating said second semiconductor chip, said second resin package body having a lower edge;  
first group interconnection leads (74) provided on said first package body to project outward from said first package body at said lower edge thereof, said first group interconnection leads including a plurality of leads each having an inner lead part held inside the first package

body and connected electrically to said first semiconductor chip, and an outer lead part located outside said first resin package body for engagement with a substrate (19);

second group interconnection leads (75) provided on said second package body to project outward from said second package body at said lower edge thereof, said second group interconnection leads including a plurality of leads each having an inner lead part held inside the second resin package body and connected electrically to said second semiconductor chip, and an outer lead part located outside the package body for engagement with said substrate (19); and

a heat dissipation lead (73) connecting said first resin package body and said second resin package body with each other, said heat dissipation lead comprising a first stage part (73a) embedded within said first resin package body for holding said first semiconductor chip thereon, a second stage part (73b) embedded within said second resin package body for holding said second semiconductor chip thereon, and a heat sink part located outside said first and second resin package bodies for bridging said first stage part and said second stage part;

each lead forming said first group interconnection leads (74) having said outer lead part at a level substantially flush with said outer lead part of said second group interconnection leads (75) such that said semiconductor device is held upright on the substrate (19) by said outer lead parts of said first and second group interconnection leads.

2. A semiconductor device as claimed in claim 1, wherein said heat sink part (73c) is projecting outwardly from the top edge of said first and said second resin package bodies so as to bridge said first stage part (73a) and said second stage part (73b) at the top of said first and second resin package bodies.

3. A semiconductor device as claimed in claim 1 or 2, characterized in that interconnection leads (74, 75) are provided to extend in the downward direction at the lower edge of said first and second resin package bodies, respectively, said interconnection leads (74, 75) are bent laterally at substantially an identical level for holding the semiconductor device (70) upright on a substrate.

FIG. 1  
PRIOR ART

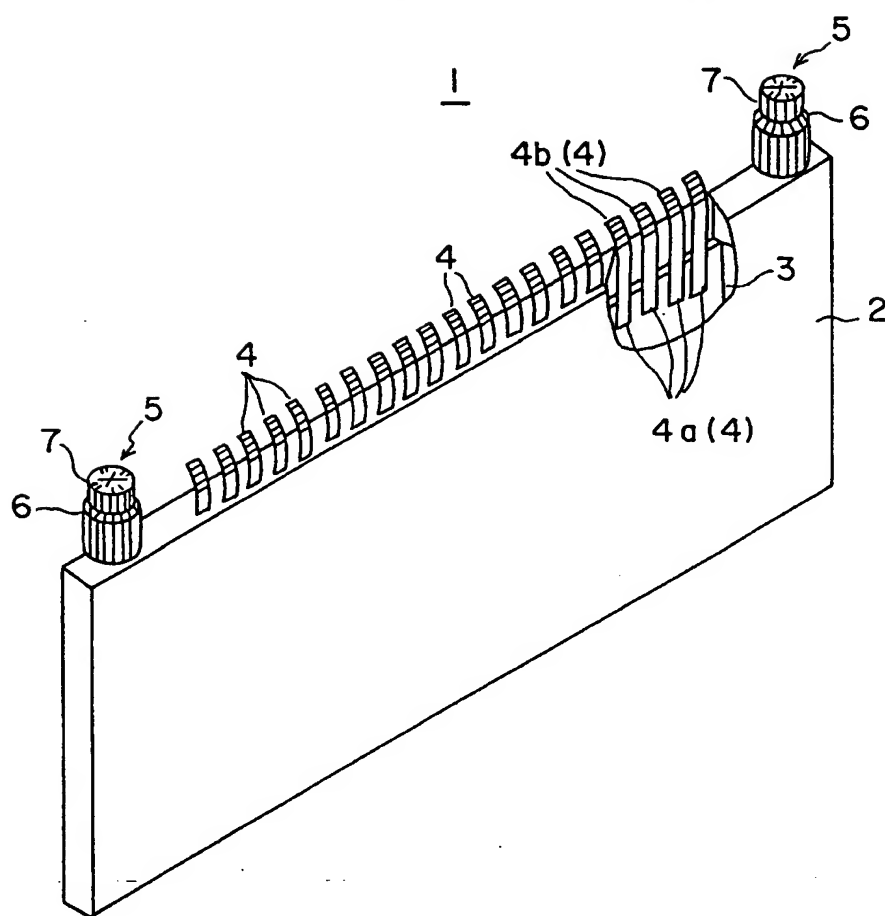




FIG. 2 PRIOR ART

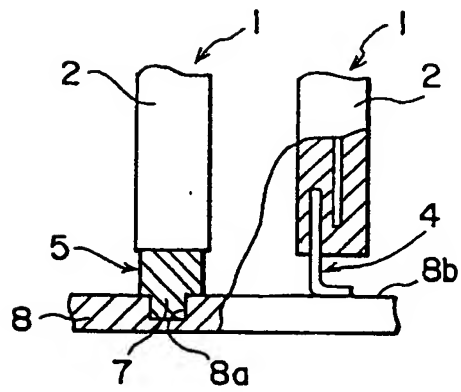


FIG. 3

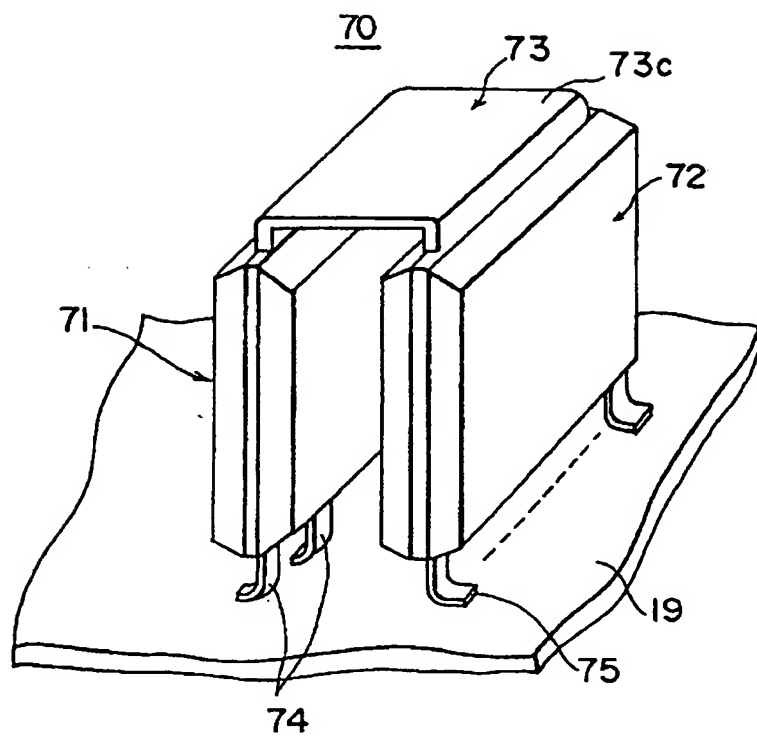
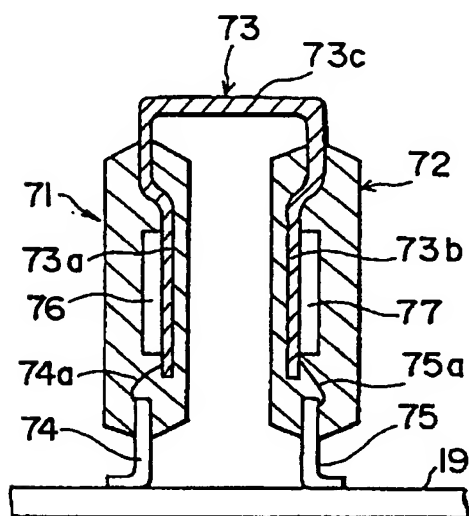


FIG. 4



5  
F/G.

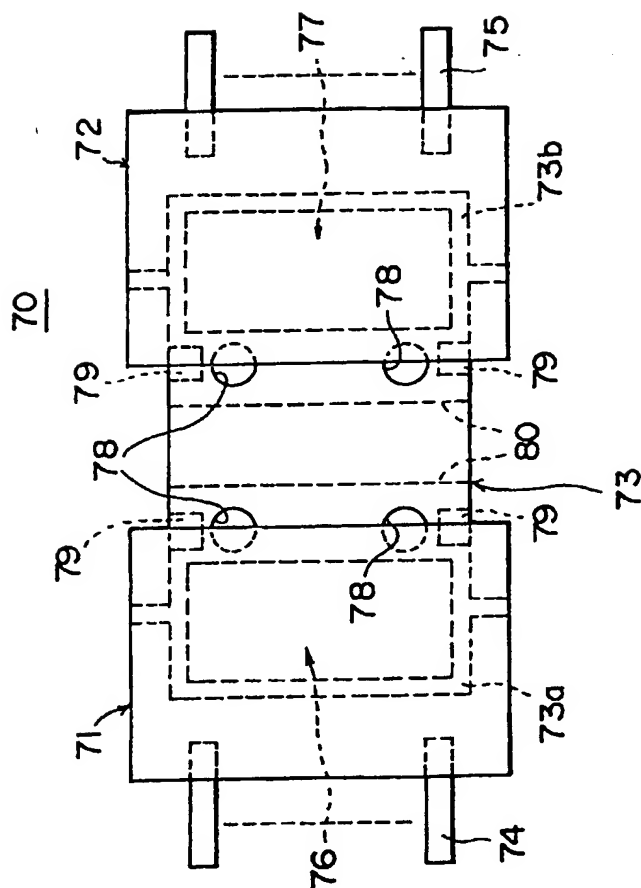


FIG. 6

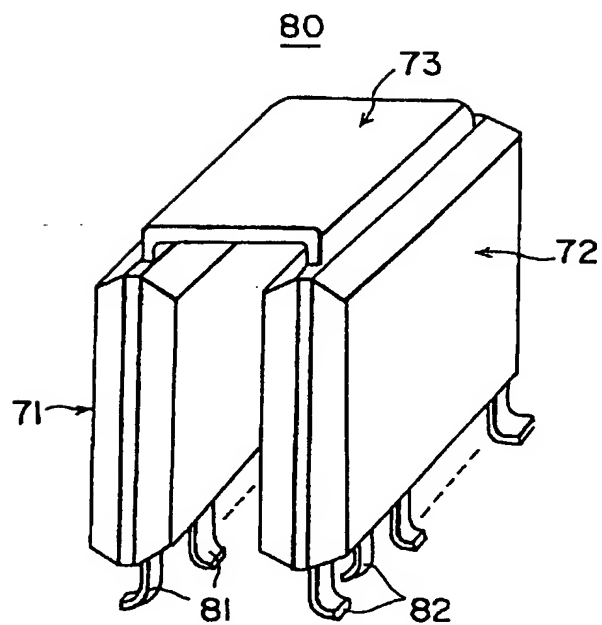


FIG. 7

